

# **Imitating Human Behaviour with Diffusion Models**

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## **Abstract**

Diffusion models have emerged as powerful generative models in the text-to-image domain. This paper studies their application as observation-to-action models for imitating human behaviour in sequential environments. Human behaviour is stochastic and multimodal, with structured correlations between action dimensions. Meanwhile, standard modelling choices in behaviour cloning are limited in their expressiveness and may introduce bias into the cloned policy. We begin by pointing out the limitations of these choices. We then propose that diffusion models are an excellent fit for imitating human behaviour, since they learn an expressive distribution over the joint action space. We introduce several innovations to make diffusion models suitable for sequential environments; designing suitable architectures, investigating the role of guidance, and developing reliable sampling strategies. Experimentally, diffusion models closely match human demonstrations in a simulated robotic control task and a modern 3D gaming environment.